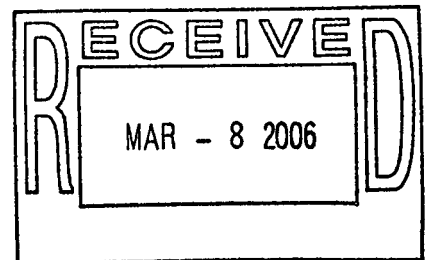


Hand-in-Hand: Stewardship and Cleanup

**Report from the Rocky Flats Stewardship Working Group
to
The Rocky Flats Coalition of Local Governments
and
The Rocky Flats Citizens Advisory Board**

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Preamble

The Rocky Flats Stewardship Working Group convened in July 1999 at the request of the Department of Energy-Rocky Flats Field Office (DOE-RFFO). The group was tasked with beginning a public process to study and make recommendations regarding the long-term stewardship needs for Rocky Flats. This group includes representatives of the Rocky Flats Coalition of Local Governments, the Rocky Flats Citizens Advisory Board, the Colorado Department of Public Health and the Environment (*ex officio*), the Department of Energy (*ex officio*), the Colorado Attorney General's Office (*ex officio*), and members of the public. The Stewardship Working Group is engaged in evaluating DOE's stewardship assumptions, analyzing the federal government's long-term liabilities and responsibilities, and participating in national stewardship dialogues. The goal of the Stewardship Working Group is to develop the information necessary regarding long-term stewardship to allow the community to effectively inform remedy selection and decision-making at Rocky Flats.

The conclusions and opinions in this report have broad support among the Stewardship Working Group participants, but do not necessarily reflect the consensus position of all participants. It is our hope and assumption that the ideas presented in this report will generate a robust public dialogue.

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Executive Summary

The Rocky Flats Stewardship Working Group was formed in July 1999 to begin a public process to study and make recommendations regarding long-term stewardship needs for Rocky Flats. This report, the first issued by the Stewardship Working Group to the Rocky Flats Coalition of Local Governments (RFCLOG) and the Rocky Flats Citizens Advisory Board (RFCAB), provides a framework for analyzing long-term stewardship and remediation decisions at Rocky Flats.

The Stewardship Working Group argues in this report that a robust stewardship analysis must be an integral part of the Rocky Flats remedy selection process. To this end, key elements of establishing, maintaining, and funding long-term stewardship activities must be considered during the remedy selection process. An analytical framework is presented in Section 1 of the report, which is intended to show how long-term monitoring and maintenance needs and the long-term effectiveness of a given stewardship control (i.e., an engineered barrier or an institutional control) should be taken into account when decisions are formulated. This framework should also assist decision-makers in considering the risks associated with the breakdown of an engineered control or institutional control during the remedy selection process.

An analysis of past remediation decisions at Rocky Flats (Section 2) highlights the Stewardship Working Group's conclusion that while Rocky Flats decision-makers and the regulatory agencies have included certain stewardship elements in their remedy selection processes, more needs to be done. Specifically, as the report details, stewardship issues have either not been part of remedy selection processes or were addressed indirectly. The Stewardship Working Group argues that the remedy selection process needs to consider long-term attributes of alternatives, such as including the specific requirements for access restrictions (define the area), the duration of the given remedy (define the time frame), the mechanisms for implementing long-term actions (define who performs and how funded), the decision criteria for terminating the given remedy (monitoring needs), and the lifecycle costs of the given remedy.

To help facilitate the incorporation of stewardship elements into the remedy selection process, the Stewardship Working Group has developed a draft stewardship "toolbox" (Section 3). The stewardship toolbox was developed to help identify and organize long-term activities necessary for an effective stewardship program in order for them to be considered during remedy selection decisions. As discussed in Section 3.2, important components or "tools" of a stewardship program include physical controls; institutional or administrative controls; performance monitoring and maintenance; information management; periodic assessment that includes continued research and development; and maintenance of a responsible controlling authority.

While the Stewardship Working Group has more work to do to expand and finalize the toolbox, the members felt it was important to begin identifying upcoming cleanup decisions in which a stewardship analysis may make a difference in the remedy selection or regulatory decision process. Section 4 identifies several of these projects. This overview highlights the important fact that there are significant decisions still to be made, many of which will present important, and potentially significant, long-term stewardship issues that will demand intensive dialogue with the community.

In Section 5, the Stewardship Working Group provides its recommendations to the Rocky Flats Coalition of Local Governments and Rocky Flats Citizens Advisory Board. These recommendations capture what the Stewardship Working Group believes are key issues that DOE and the regulatory agencies must address. The recommendations are as follows:

1. Stewardship must be a key parameter of the decision making process for selecting remedies. Among the requirements that need to be considered to ensure the long-term protection of human health and the environment are access restriction requirements, duration of the remedy, mechanisms for implementing long-term stewardship obligations and requirements, decision criteria for terminating the remedy, requirements for periodic reviews, and long-term costs. Exactly how much stewardship planning will be required at the remedy selection phase is still an open question that necessitates continued public dialogue.
2. Remedies evaluated should also include measures that have a high degree of certainty and layering of multiple mechanisms to ensure the remedy will meet the end-state objectives for the life of the contaminant.
3. The DOE manager must provide guidance for integrating stewardship into the remedy selection process.
4. DOE and Kaiser-Hill should each designate an on-site stewardship program manager to coordinate the stewardship program. Each person should have decision-making authority.
5. DOE and Kaiser-Hill must clarify Kaiser-Hill's responsibilities under the closure contract to incorporate stewardship into cleanup planning.
6. The RFCA principals need to establish a set of guidelines directing how stewardship will be incorporated into remedy selection processes.

1 Introduction

The Rocky Flats Environmental Technology Site and the open space surrounding it have been described as the “crown jewel” of the Denver metropolitan area. Once cleanup and closure are complete and remnants of the Cold War nuclear weapons plant are gone, tallgrass prairie, tall upland shrubland, and wetlands will remain. Unfortunately, it will not be as pristine as the naked eye may lead one to believe. This prairie will contain residual contamination, including plutonium, uranium, volatile organic compounds (VOCs), and other hazardous substances. This remaining contamination thus creates the challenge of ensuring continued long-term protection of human health and the environment, which will in turn require the implementation of a comprehensive and effective long-term stewardship program. As this report will assert, identifying and planning for stewardship needs should begin long before the closure of Rocky Flats.

1.1 How Does the Stewardship Working Group Define “Stewardship”?

There are various definitions for “stewardship”, none of which are entirely comprehensive. “Stewardship” has been defined as “accepting responsibility for and implementing activities necessary to maintain long-term protection of human health and the environment from the hazards posed by residual radioactive and chemically hazardous materials.” (Rocky Flats Stewardship Dialogue Planning Group, 1999) Stewardship is a broad term used to describe the activities that will be conducted after remediation activities are completed. These activities include physical controls (i.e. access barriers), institutional controls (i.e. lease agreements, access restrictions, zoning, etc.), monitoring and maintenance, information management, education, research and development of new technologies, funding, and regulations.

There will be a set of baseline stewardship activities in place no matter which remedies are selected, since it is presumed Rocky Flats will not be cleaned to unrestricted use levels. As discussed in Section 4, the Stewardship Working Group refers to these stewardship needs as “fixed.” Stewardship needs that will vary depending on cleanup decisions are referred to as “variable.”

1.2 Why Is Stewardship Important?

As mentioned above, cleanup and closure at Rocky Flats does not mean the elimination of residual contamination and related risks, for there are technical, fiscal, and policy/political constraints that will necessitate leaving some contamination on-site. The primary radioactive contaminant of concern at Rocky Flats, Plutonium-239, has a half-life of 24,000 years. Plutonium and other hazardous materials will remain long after closure and will require long-term monitoring and maintenance in order to protect human health and the environment. Because many long-term stewardship requirements at Rocky Flats will flow directly from today’s cleanup decisions, it is imperative from a long-term health and safety perspective to focus on stewardship during Site remediation.

While the total amount of residual contamination that will remain on-site after closure has not been determined, the Department of Energy (DOE), the Environmental Protection Agency

(EPA), and the Colorado Department of Public Health and the Environment (CDPHE) presume that engineered barriers, such as caps and containment dams, will be used and institutional controls, such as access restrictions, will be employed at the time of closure. The risks posed by the breakdown or malfunction of an engineered barrier or institutional control are potentially great. In a recent report to DOE, the National Research Council (NRC) argues that DOE must plan for uncertainty and fallibility at all stages of the decision-making process. Additionally, unknowns such as final cleanup levels and methods for achieving a given standard (i.e., contaminant reduction or contaminant isolation measures) will directly affect stewardship needs at closure.

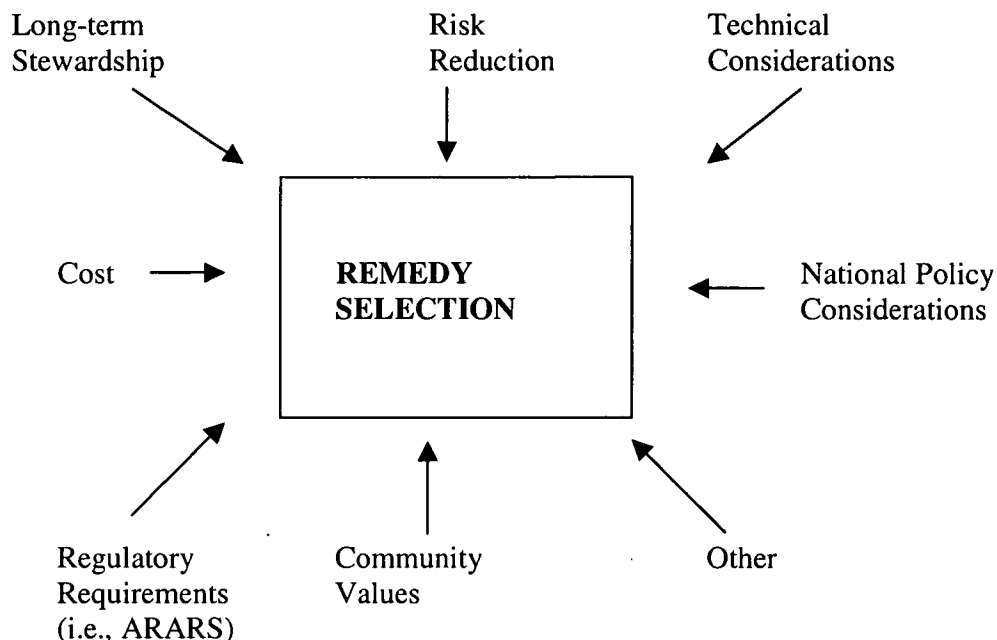
As DOE moves closer to closure at Rocky Flats, we are faced with several questions – how should the federal government clean up Rocky Flats to protect future generations from residual contamination knowing that “cleanup” does not mean the elimination of related risks? How do we manage for the “long-term”, understanding that this time span can only be measured in geologic terms, a timeframe that far exceeds our collective abilities and existing technologies? How do we plan for the uncertainties that the NRC identifies?

There are no easy answers and no true solutions to these problems. The Stewardship Working Group strongly believes part of the answer lies in integrating stewardship needs into the remedy selection process. That means long-term stewardship issues and obligations must be explicit when examining remedial alternatives and implementing a final remedy.

1.3 Why Stewardship Must Be Incorporated Into the Remedy Selection Process

In planning for the inherent uncertainties and risks associated with long-term stewardship, the NRC recommends developing and implementing a systematic approach to cleanup, in which contaminant reduction, contaminant isolation, and stewardship are treated as an integrated, complementary system. Although the approach suggested by the NRC is essential, it does not comprehensively address all of the problems associated with residual contamination or uncertainties associated with selected remedies.

The Stewardship Working Group advocates going one step further and including a robust stewardship analysis during the remedy selection process. To illustrate this point, the Stewardship Working Group has developed the following diagram:



This diagram, while general in nature, captures what the Stewardship Working Group believes are eight key inputs into the remedy selection process. Each of the eight categories with arrows pointing to “remedy selection” are either identified in Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) regulations as being key elements of a remedy selection process, or represent practical realities of how remedies are chosen.

The highest priority in remedy selection must be the long-term safety and health of the community surrounding Rocky Flats and protection of the environment. The Stewardship Working Group thus concludes that key aspects of establishing, maintaining and funding long-term stewardship activities must be considered during the remedy selection process. Following such an analytical framework should serve to ensure that the long-term monitoring and maintenance needs and the long-term effectiveness of a given stewardship control (i.e., an engineered barrier or an institutional control) are considered when decisions are formulated. This framework should also assist decision-makers in considering the risks associated with breakdown of an engineered control or institutional control during the remedy selection process.

1.4 Organization of the Stewardship Working Group Report

The purpose of this report is to emphasize the importance of incorporating long-term stewardship into the remedy selection process, and offer guidance as to how this incorporation can best be accomplished. To that end:

Section 2 provides a review of stewardship elements in past cleanup decisions at Rocky Flats, as well as a case study of the Solar Ponds Plume remedy decision. Future case studies will be reviewed as they arise.

Section 3 describes the draft stewardship toolbox and how it can be applied during remedy selection.

Section 4 describes specific areas of contamination at Rocky Flats where cleanup decisions have not yet been made, but where stewardship issues could impact the remedy analysis. In future reports, the Stewardship Working Group hopes to illustrate how the stewardship toolbox can be applied to remedy decisions affecting these areas.

Section 5 summarizes the Stewardship Working Group's conclusions and offers six recommendations for how to help achieve the goals identified in this report.

As you read the report, bear in mind that these ideas and conclusions are merely a snapshot in time. The Stewardship Working Group plans to continue observing the cleanup process and convey new recommendations to both the RFCLOG and the RFCAB

2 Stewardship Considerations in Past Remedy Selections at Rocky Flats

In order to understand how stewardship issues can and should be addressed in remedy selections, the Stewardship Working Group found it helpful to first review past cleanup decisions (or remedy selections) at Rocky Flats. Cleanup decisions have been implemented for several contaminated areas, known as operable units (OUs). An OU is an area or set of areas that may require remediation. Smaller areas within an OU are sometimes designated as Individual Hazardous Substance Sites, (IHSSs).

Two OU decisions are discussed below and reviewed for their stewardship considerations. As an additional example, the Solar Ponds Plume remedy decision serves as a good model for analyzing the role of stewardship in recent cleanup actions at Rocky Flats. That decision is discussed in Section 2.2.

2.1 Operable Unit CAD/RODs

To date, five final cleanup decision documents (known as Corrective Action Decision/Record of Decision [CAD/ROD]) have been signed for OU closures at Rocky Flats. Table A, on page 7, presents a summary of these decisions, including the long-term features selected for each. Three of the areas were determined to need no further action. OU 1 (881 Hillside) and OU 3 (Off-site Areas) are discussed more in depth below.

As one reviews these decisions, it is important to note the context in which they were made. These decisions were not necessarily subject to the same influences as cleanup actions would be today or in the future. The focus on stewardship is different now than in the past. At the time of these decisions, either closure was expected in 2010 or 2015, or the current 2006 closure schedule was not taken as seriously as it is now. Furthermore, DOE and EPA had not yet developed long-term stewardship guidance, so there was little understanding of how best to comprehensively address long-term needs during remedy selection.

2.1.1 OU 1

The remedy selected for OU 1 was initially a groundwater pump-and-treat process combined with removal and treatment of a large volume of soil. The goal of the project was to remove the majority of VOCs in the soil and water. In a recently approved modification, a monitored natural attenuation remedy was chosen to replace the existing french drain system as no concentrated source of contamination has been identified.

This recent OU 1 decision modification addresses and considers certain stewardship needs. The decision to change the remedy from an active system (french drain/ pump and treat system) to the current passive system (monitored natural attenuation) was in part based on the desire to reduce monitoring and maintenance needs. The decision document also indirectly identifies that long-term monitoring and maintenance will be necessary.

Yet, in reaching this decision, the Rocky Flats decision-makers confirmed they were only considering the system needs through closure. Thus, the majority of stewardship decisions for this area are deferred until the final CAD/ROD document for the entire site is prepared at the end of the cleanup project. In the modification, there was little or no consideration of specific long-term stewardship needs in the areas of monitoring, access restrictions, or lifecycle costs for implementing the remedy. Additionally, because the modification does not define the area that will require restrictions in the future, additional studies of the extent of contamination may be required at closure.

2.1.2 OU 3

OU 3 is a set of contaminated areas beyond the Site boundary. In 1997, DOE and the regulatory agencies considered whether these areas should be remediated, and concluded that no active remediation would be undertaken. This decision was based on a determination that the levels of contamination in these areas posed little risk to public health and the environment.

The OU 3 CAD/ROD stipulates that the decision to not remediate will be assessed as part of required CERCLA five-year reviews. The agencies are to determine if there are any new regulatory information or methods that would change the accepted levels of radioactive materials in these off-site areas. Nothing in the CAD/ROD specifies how this five-year review will be funded or conducted. Since these lands are not located on Rocky Flats property, the institutional controls that are in place are the responsibility of the cities of Broomfield and Westminster.

Table A. Long-term Aspects of Rocky Flats Operational Unit Closure Documents

Closed Operational Unit	CAD/ROD Signing Date	Selected Remedy	Long-Term Features N = not used, S = specifically included, G = generally included						Comments
			Access Restrictions	Monitoring	Maintenance	Replacement	Records Management	Five Year Review	
1 (881 Hillside)	3/12/97	Excavation and treatment of contaminated soils at IHSS 119.1. Pumping and collection of groundwater wells and a french drain, and treatment in B891	G	S	N	N	G	S	Surface soil contamination addressed jointly with Buffer Zone OU, and surface water and sediments will be addressed with OU 5. Institutional controls will be used for protection of open space and for limiting groundwater use.
1 (881 Hillside) (Modified)	Approval 10/30/00	Monitor the pumping well as a plume definition well (monitored natural attenuation)	G	S	N	N	G	S	Discontinue excavation, pump and treat system and french drain after one year. Institutional controls will still be used.
3 (The Off-site Areas)	4/14/97	No Action, but conduct a five-year review or less to ensure consistency with future national standards for radionuclides	S	N	N	N	N	S	Cleanup levels of radionuclides in this area were based on calculations. New regulations or new modeling or calculation methods may make remedial action necessary. Habitat and species protection may be necessary.
11 (West Spray Field)	9/29/95	No Action	N	N	N	N	N	N	No surficial contamination is above levels of concern. This area is open to unrestricted use, including mining.
15 (Inside Building Closures)	9/21/95	No Action on 3 IHSSs Deferral of Action on 3 IHSSs until their buildings close	N	N	N	N	N	N	All six IHSS's were clean closures, but 178, 211 and 217 faced a No Action CERCLA decision while 179, 180 and 204 faced a deferral of actions until their buildings close.
16 (Low Priority Sites)	Aug-94	No Action on 5 IHSSs Deferral of Action on IHSS 196 as part of OU 5 and IHSS 197 as part of OU 13	N	N	N	N	N	N	Amounts of VOC's released in these areas will have degraded to acceptable limits since their release. Exposure pathways are not complete, so there is no unacceptable risk to human health and the environment.

2.2 Solar Ponds Plume Remedy Decision

In addition to the OU decisions discussed above, Rocky Flats conducts some cleanup projects on an 'interim' basis. According to the Rocky Flats Cleanup Agreement (RFCA), the regulatory document driving cleanup, these decisions are not final and are subject to review at the time of the final CAD/ROD for the entire site. However, it is expected that most decisions will not change significantly. One example of this type of cleanup action is the mitigation of a contaminated groundwater plume at the Solar Evaporation Ponds.

Five Solar Evaporation Ponds (ponds) in the northeast corner of the Protected Area (PA) were used from 1953 to 1986 to store and evaporate process wastes and other liquids. Removal of the sludge from these ponds was completed in January, 1995. However, seepage from the ponds

formed a groundwater plume extending north and east from the ponds to the North Walnut Creek drainage. This groundwater plume contains both nitrate and uranium.

Six interceptor ditches were installed in 1971 and were replaced by an Interceptor Trench System in 1981. The water collected in the system was pumped to modular storage tanks, and water from the tanks was subsequently transferred to Building 374 for flash evaporation. This treatment system is energy intensive with high operation and maintenance costs. Also, the system was not effective in capturing all contaminated groundwater flow from the ponds. Consequently, in 1997, DOE and Kaiser-Hill began evaluating more cost-effective treatment technologies for this groundwater plume. Although reducing the cost of treatment of the plume water was the primary reason for identifying an alternate treatment method, the Site was also looking to identify a long-term solution for the contaminated plume.

Alternate treatment technologies were evaluated for their ability to meet a number of long-term goals for the plume and for Rocky Flats:

- ensure compliance with stream standards for nitrate and uranium;
- provide a long-term, passive solution to the movement of contaminated groundwater from the ponds area to North Walnut Creek;
- support the goals of the RFCA and the Site Closure Plan which call for site closure within 10 years;
- significantly reduce plume water management and treatment costs; and
- meet the fiscal year 1999 milestone for initiating remediation of the plume.

The comparative analysis that led to the selection of a treatment technology was based on three criteria: effectiveness, implementability, and cost. Two additional factors were also given serious consideration in the remedy selection: preserving the habitat of a threatened species (Preble's meadow jumping mouse) during construction and remediation, and long-term effectiveness. Based on these factors, passive remediation methods were favored.

The remedy selected was the installation of a collection trench, which would use a cell containing iron and organic media to treat the groundwater plume. A temporary modification to the water quality stream standards was granted by the State, thereby increasing the amount of nitrate allowed into the stream, so that groundwater not captured by the new barrier would not cause an exceedance of the Site water standard. Details of the remedy and the remedy selection process are described in the "Final Solar Ponds Plume Decision Document."

The Stewardship Working Group analyzed this cleanup decision in relation to the remedy selection diagram on page 3. Table B, shown on page 9, lists the different remedy selection criteria. The right-hand column shows which stewardship needs were considered in the Solar Ponds Plume remedy selection.

Table B: Solar Ponds Plume Remedy Selection Considerations

Factors to Consider As Identified By SWG	How Factors Were Considered in Remedy Selection
Risk Reduction	Remedy chosen to comply with stream standards for nitrate and uranium.
Technical Considerations	Reactive barrier chosen that would chemically reduce the nitrate and immobilize the uranium. Groundwater flow and transport models were used to evaluate the proposed remedial actions. Uses available and established technology.
National Policy Considerations	Not specifically addressed during remedy selection.
Community Values	Not specifically addressed during remedy selection.
Other	Remedy chosen to have minimal impact to Preble's meadow jumping mouse habitat.
Regulatory Requirements	Considered in detail, see final report for description.
Costs	Capital, operation, and maintenance costs considered.
Stewardship Needs	With continued operation and maintenance and treatment media changeout, solution effective over the long-term. Remedy does not require elements of the RFETS infrastructure that are likely to be abandoned. Plan specifies continuing groundwater monitoring.

Our analysis leads us to conclude that Rocky Flats did a reasonable job at considering stewardship needs during the Solar Ponds remedy selection process. However, as discussed in Section 2.3 below, more can and should be done. While stewardship issues were not explicitly considered as part of the remedy selection, some stewardship issues (passive system; need to remove, dispose, and replace iron filings) were addressed implicitly. In addition, field changes were made in the system design that require different flow conditions for the system to operate as designed. These changes are currently being evaluated to determine their impact on future operations and remedy effectiveness. That decision will likewise raise long-term stewardship issues.

2.3 Lessons Learned from Past Cleanup Decisions

This review of past decisions highlights several areas for future emphasis. In the examples we presented, stewardship issues were considered indirectly and not in any depth. Instead, the remedy selection process needs to directly consider long-term attributes of alternatives, including the specific requirements for access restrictions (define the area), the duration of the remedy (define the time frame), the mechanisms for implementing long-term actions (define who performs and how it will be funded), the decision criteria for terminating the remedy (define monitoring needs), and the costs. Cost estimates should include a contingency in anticipation of unexpected costs, as illustrated by the Solar Ponds example.

These long-term attributes must be defined at the remedy selection stage. Otherwise, subsequent activities and costs may be necessary to provide this definition in the future in order for the remedy to be effective. As seen in the OU1 example, the extent of access restrictions was not

defined in the remedy selection but will be required in the final CAD/ROD. Thus, additional costs will likely be incurred.

Additionally, the requirements for periodic performance reviews of remedies need to be defined in the context of the remedy objectives, and therefore, should also be defined during the remedy selection process. Indeed, in cases where the definition of remedy objectives has been vague, defining the performance review requirements early-on may help to identify this deficiency. For example, the OU3 CAD/ROD mandates a periodic review of radiological criteria, but no mechanism for performing this review is identified. Since the effectiveness of the OU3 remedy must be ascertained through this periodic review, the details of the review need to be defined. These requirements may also inform the decisions about the identity of the organization performing the review and their funding needs. The periodic review will also help the agencies determine when the remedy may be terminated.

Although it may be appropriate to defer some of the implementation details for long-term actions until closure, the extent of stewardship needs and obligations that should be considered during the remedy selection phase is still an open question that should be determined by a public dialogue.

As a first step towards incorporating these ideas of defining and integrating stewardship actions, the DOE-RFFO manager needs to provide guidance on how the Site should integrate stewardship into the remedy selection process. Additionally, DOE and Kaiser-Hill need to clarify Kaiser-Hill's contractual obligations to include long-term stewardship as part of its remedy selection analysis. The Stewardship Working Group firmly believes that the integration of the long-term monitoring and maintenance needs into remedy selection is mandated by the CERCLA requirement that provides for long-term protection of human health and the environment.

Incorporating these disparate concepts into a remedy selection process can be a complex endeavor, particularly given the number of unknowns and undefined parameters. Two additional steps DOE and the regulators can take to implement these suggestions would be: 1) DOE and Kaiser-Hill should each designate a stewardship program manager with decision-making authority; and 2) the RFCA principals should develop a set of guidelines directing how stewardship will be integrated into Site planning. The next section attempts to provide a framework for incorporating stewardship elements into remedy selection.

3 Development and Utilization of a Stewardship Toolbox

It is relatively easy to identify areas for improvement regarding the consideration of stewardship during the remedy selection process. What is more difficult is developing an analytical framework for evaluating stewardship needs. In an attempt to take stewardship from the theoretical to the practicable, the Stewardship Working Group has developed what we are calling the stewardship “toolbox”.

The version of the toolbox contained in this report should be considered a work in progress. The Stewardship Working Group intends to devote additional time to more fully develop the toolbox, focusing on providing additional detail for each of the stewardship elements described below. Another report will likely follow.

3.1 Stewardship Toolbox Concept

The goal of the stewardship “toolbox” is to identify and organize the long-term activities necessary for a stewardship program so that they may be considered in remedy selection decisions. As discussed in Section 3.2, important components or “tools” of a stewardship program include physical controls; institutional or administrative controls; performance monitoring and maintenance; information management; periodic assessment that includes continued research and development; and maintenance of a responsible controlling authority.

The toolbox, once fully developed, is intended to be applied during various stages of the cleanup project, not just during remedy selection. The toolbox should first be used in developing an overall framework for how stewardship elements would be applied to remedy selection, thus providing one of the bases for the selection of remedies for the various cleanup areas onsite. Once the toolbox has been utilized for each specific area of contamination, it should then be applied to the entire Site to better assess the collective Site-wide stewardship needs and obligations.

3.2 Stewardship Toolbox Considerations

Organization of the toolbox centers around six major categories, each of which both individually and collectively focus on helping to ensure that the chosen remedies remain protective of human health and the environment for the life of the contaminants. The six toolbox categories are as follows:

- 1) Physical controls: Physical controls include, but are not limited to, containment structures such as caps, water diversion and treatment systems, and access barriers, such as fences, guards and signs. These controls “physically” reside at the Site of or in near proximity to the actual contamination. Once these systems are in place, it is important that they function as designed for the anticipated life of the contaminants.
- 2) Institutional/Administrative Controls: This category includes governmental controls such as zoning, permits, and use restrictions; proprietary controls such as easements and covenants; legal enforcement tools such as administrative orders and consent decrees;

and informational devices such as deed notices, registries and advisories. In most contexts, these controls work in tandem with physical controls to serve as an additional layer of protection.

- 3) Monitoring / Maintenance: Controls, whether physical or institutional/administrative, require periodic monitoring and maintenance to ensure they continue to work as designed. A contingency plan should likewise be maintained and be ready for implementation should a control fail or not work as designed.
- 4) Information Management: It is vitally important that a repository be established to hold information related to areas where residual contamination remain following active remediation, and where any type of controls, either physical, institutional/administrative, or both, are in place. Information must be maintained concerning the operative history of the contaminated Site, the contaminants of concern, the selected remedy, the use of controls along with their monitoring and maintenance records, and any other information judged necessary for succeeding generations to understand the nature and extent of the residual contamination and related risk to human health and the environment should the controls fail.
- 5) Periodic Assessment: A regular assessment process should be instituted that has two principal foci. First, an assessment should be conducted to determine whether the selected remedy and controls for an area of contamination continue to operate as designed. This assessment would include actions such as evaluating monitoring and maintenance records, looking at how information records are being maintained, verifying regulatory compliance, and determining whether land use assumptions are still valid. An important part of managing the assessment program is to develop and be ready to implement contingencies in the event of failed performance of either the remedy or its associated controls. Second, in keeping with an ultimate goal that elimination of contamination is preferable to maintaining long-term stewardship in perpetuity, periodic reassessment of contaminated areas should be conducted to ascertain whether new technologies might exist to eliminate the contaminants in a safe and cost-effective manner.
- 6) Controlling Authority: Long-term protection of human health and the environment necessitates that a controlling authority(ies) be established with responsibility for overall program management and guidance. The authority will monitor the long-term stewardship program, making sure that activities such as routine monitoring and maintenance are conducted on schedule, that unfavorable conditions are corrected, and that funding for program implementation is secured. In addition, there should be a separate external authority, not affiliated with the entity responsible for overall management of the stewardship program, who would serve as an overseer of the work accomplished. This external authority would provide independent verification that the overall stewardship program is meeting its goals.

3.3 Development and Application of the Stewardship Tools

One of the key characteristics of the stewardship tools is their interdependent nature. For example, physical controls will almost always require institutional/administrative controls to remain operational and functioning. Likewise, monitoring and maintenance of both the physical and institutional/administrative controls will be required to assess and ensure their performance. Information will need to be maintained about the physical and institutional/administrative controls, as well as the records of their monitoring and maintenance. Comprehensive periodic assessments can be conducted by examining well-kept records about stewardship controls and their monitoring and maintenance. The controlling authority will be charged with ensuring that controls remain in place, that they are maintained, that information is collected, and that the periodic assessment program is implemented and corrective actions taken if necessary.

The draft toolbox in Example 1 below is offered as a means to organize the six stewardship tools discussed in Section 3.1. As one starts at the top left of the toolbox and goes across, it is anticipated that the attributes of a comprehensive stewardship program can be developed and input into the toolbox. Once the top row for a given remedy is completed (see Example 2 – Figure 2), the stewardship program attributes for each category should then be recorded down the first column of the toolbox (see Example 2 – Figure 3). In this way, each aspect of the stewardship program can be evaluated for additional considerations. The evaluation process should be completed for each of the succeeding rows (see Example 2 – Figure 4). Once information has been recorded for each of the toolbox squares, a summary of the stewardship program, by element, can be achieved by reading down the columns. There may be open squares once the entire matrix has been developed.

Example 1

	Chosen Remedy	Physical Controls	Institutional / Administrative Controls	Monitoring and Maintenance	Information Management	Periodic Assessment	Controlling Authority
Chosen Remedy							
Physical Controls							
Institutional / Administrative Controls							
Monitoring and Maintenance							
Information Management							
Periodic Assessment							
Controlling Authority							

An illustration using the toolbox is outlined in the figures of Example 2 below. In this example, we assume that the selected remedy is a protective cap. The first step in developing the framework of stewardship considerations is to record the selected remedy in the appropriate box at the upper left hand corner of the table (see Example 2, Figure 1).

Example 2 –Figure 1

	Chosen Remedy	Physical Controls	Institutional / Administrative Controls	Monitoring and Maintenance	Information Management	Periodic Assessment	Controlling Authority
Chosen Remedy	Cap						

The next step is to then work towards the right in this first row, developing stewardship considerations related to the use of the cap (see Example 2 - Figure 2).

Example 2 – Figure 2

	Chosen Remedy	Physical Controls	Institutional / Administrative Controls	Monitoring and Maintenance	Information Management	Periodic Assessment	Controlling Authority
Chosen Remedy	Cap	Fences, signs	Deed, well drilling restrictions	Downstream wells; Routine Maintenance	Historical, contaminants, remedy documents	Is it working as designed? Is there a better option today?	Direct program; secure funding

The first stewardship question to consider falls under the category “Physical Controls.” Here the question concerns whether additional physical controls are necessary to provide maximum protection of human health and environment at the cap location. One would need to consider all environmental pathways such as, but not limited to, air transport, surface and groundwater transport, and physical intrusion. For this example, because we want to ensure that there is no physical intrusion of the cap, fences or signs might be appropriate.

After thoroughly examining physical controls for all possible exposure pathways, the next step would be to consider institutional/administrative controls related to the use of a cap. Again considering all environmental pathways, it may be determined that the groundwater pathway is of concern, necessitating deed restrictions to the property that would restrict digging in the area such as well drilling.

Continuing across the first row, the next category is monitoring and maintenance needs for the cap. Next would be information management needs, followed by details of a comprehensive periodic assessment program. Finally, a controlling authority should be identified that will have responsibility for planning, implementing and evaluating the stewardship program.

As one begins to develop information along the first row of the table, it is important to record the same information down the first column, so that the interdependent considerations of the stewardship program can be recorded (see Example 2 - Figure 3).

Example 2 – Figure 3

	Chosen Remedy	Physical Controls	Institutional / Administrative Controls	Monitoring and Maintenance	Information Management	Periodic Assessment	Controlling Authority
Chosen Remedy	Cap	Fences, signs	Deed, well drilling restrictions	Downstream wells; Routine Maintenance	Historical, contaminants, remedy documents	Is it working as designed? Is there a better option today?	Direct Program; secure funding
Physical Controls	Fences, signs						
Institutional / Administrative Controls	Deed, well drilling restrictions						
Monitoring and Maintenance	Downstream wells; Routine Maintenance						
Information Management	Historical data, info on contaminants, remedy documents						
Periodic Assessment	Is it working as designed? Is there a better option today?						
Controlling Authority	Direct Program; secure funding						

Next, the toolbox allows us to consider the range of stewardship issues for the physical controls we identified to augment the use of the cap (fences and signs). Likewise, the institutional/administrative controls may require some form of monitoring, information management, periodic assessment, and a controlling authority (see Example 2 – Figure 4). Following the example in Figure 2, one must fill in the toolbox for each of the controls identified in the vertical column.

Example 2 – Figure 4

	Chosen Remedy	Physical Controls	Institutional / Administrative Controls	Monitoring and Maintenance	Information Management	Periodic Assessment	Controlling Authority
Chosen Remedy	Cap	Fences, signs	Deed, well drilling restrictions	Downstream wells; Routine Maintenance	Historical, contaminants, remedy documents	Is it working as designed? Is there a better option today?	Direct program; secure funding
Physical Controls	Fences, signs		Deed Requirements	Routine inspections, maintenance and repairs	Inspection and maintenance records	Have they provided necessary protection?	Direct program; secure funding
Institutional / Administrative Controls	Deed, well drilling restrictions	N/A		Periodic review of records	Keep records on file	Have they provided necessary protection?	Direct program; secure funding
Monitoring and Maintenance	Downstream wells; Routine Maintenance						
Information Management	Historical data, info on contaminants, remedy documents						
Periodic Assessment	Is it working as designed? Is there a better option today?						
Controlling Authority	Direct program; secure funding						

After having completed an assessment of each square in the table, the components of a comprehensive stewardship program should be apparent. Again, there may be blank squares in the table (see Example 2 – Figure 5).

Example 2 – Figure 5

	Chosen Remedy	Physical Controls	Institutional / Administrative Controls	Monitoring and Maintenance	Information Management	Periodic Assessment	Controlling Authority
Chosen Remedy	Cap	Fences, signs	Deed, well drilling restrictions	Downstream wells; Routine Maintenance	Historical, contaminants, remedy documents	Is it working as designed? Is there a better option today?	Direct program; secure funding
Physical Controls	Fences, signs		Deed Requirements	Routine inspections, maintenance and repairs	Inspection and maintenance records	Have they provided necessary protection?	Direct program; secure funding
Institutional / Administrative Controls	Deed, well drilling restrictions	N/A		Periodic review of records	Keep records on file	Have they provided necessary protection?	Direct program; secure funding
Monitoring and Maintenance	Downstream wells; Routine Maintenance	N/A	N/A		Keep records on file	Is the periodicity proper? Are things functioning?	Direct program; secure funding
Information Management	Historical data, info on contaminants, remedy documents	N/A	N/A	Periodically assess which documents or info can get rid of		Is the proper info being kept?	Direct program; secure funding
Periodic Assessment	Is it working as designed? Is there a better option today?	N/A	N/A	N/A	Need to keep records of assessment		Direct program; secure funding
Controlling Authority	Direct program; secure funding	N/A	N/A	N/A	Need to keep records of controlling authority's actions	Need to provide independent external oversight	

Please note that the information contained in Example 2 is meant solely as an illustration of how to use the toolbox and is not intended as an exhaustive analysis of the stewardship program needs associated with choosing a protective cap as a selected remedy. A more thorough analysis would identify additional program needs that should be recorded in the table.

As outlined in this report, a very important consideration for any remedy selection decision is the accompanying stewardship program needs. Implicit in that consideration is the necessity of considering the life-cycle costs. It will be important for the remedial program manager to identify the cost associated with each element of the stewardship program by assigning a cost

value to each square of the toolbox. The cost information will help inform the remedy selection process.

Other examples using the stewardship toolbox are included as Example 3, outlining a remedy involving natural attenuation of a chemically contaminated groundwater plume, and Example 4, removal of contaminated soil to a prescribed action level. As with Example 2, the information contained in these examples is not meant to be exhaustive of the complete stewardship program needs for the given remedy. Rather, the information is illustrative of the type of information that needs to be considered and included in the table. It is assumed that additional program needs will be added as a thorough analysis of the stewardship program is undertaken.

The stewardship toolbox is offered at this time as a means to conceptualize and then organize stewardship program needs for remedial action decisions. Much analysis remains to be done concerning the multitude of actual stewardship tools that may be used. The Stewardship Working Group will continue its discussions concerning these tools and how they should be applied to actual remediation decisions at Rocky Flats. As outlined in the next section of this paper, there are numerous contaminated areas at Rocky Flats that will require a thorough and comprehensive stewardship analysis as remedies are selected.

Example 3

	Chosen Remedy	Physical Controls	Institutional / Administrative Controls	Monitoring and Maintenance	Information Management	Periodic Assessment	Controlling Authority
Chosen Remedy	Monitored Natural Attenuation of Chemically Contaminated Groundwater Plume	Sign indicating area of contamination	Well drilling permit requirements and restrictions	Monitoring program to determine effectiveness of strategy and to monitor contaminant movement	Historical: description of area of contamination and contaminants of concern; info on remedy selection;	Review of monitoring data; determination if new technology exists to improve performance	Direct program; secure funding
Physical Controls	Sign indicating area of contamination		Written notification that signs must be maintained in area	Periodic inspection of signs and repair or replacement if necessary	Inspection reports	Review inspection reports; determine if intrusions are being made	Direct program; secure funding
Institutional / Administrative Controls	Well drilling permit requirements and restrictions	N/A		Periodic review of records	Record information regarding need to maintain controls	Periodic review of records	Direct program; secure funding
Monitoring and Maintenance	Monitoring program to determine effectiveness of strategy and to monitor contaminant movement	N/A	N/A		Retain monitoring and maintenance records	Periodic review of records	Direct program; secure funding
Information Management	Historical: description of area of contamination and contaminants of concern; info on remedy selection;	N/A	N/A	Periodic review of records to determine retention needs		Periodic review of records	Direct program; secure funding
Periodic Assessment	Review of monitoring data; determination if new technology exists to improve performance	N/A	N/A	N/A	Maintain records of assessments		Direct program; secure funding
Controlling Authority	Direct program; secure funding	N/A	N/A	N/A	Maintain records of activities	Independent external oversight	

Example 4

	Chosen Remedy	Physical Controls	Institutional / Administrative Controls	Monitoring and Maintenance	Information Management	Periodic Assessment	Controlling Authority
Chosen Remedy	Soil removal to Tier I action levels with residual contamination above background levels	Signs indicating area of residual contamination; possibly fences limiting access	Deed restrictions on property	Periodic soil sampling and water sampling downstream to detect possible migration	Historical information about Site and chosen remedy; info on COCs.	Determine stability of contamination and possibility of migration; review technology to determine ability for further cleanup	Direct program; secure funding
Physical Controls	Signs indicating area of residual contamination; possibly fences limiting access		Deed restrictions requiring use of controls	Inspections, maintenance and replacement of controls	Info regarding requirements of controls; monitoring and maintenance reports	Review monitoring and maintenance records	Direct program; secure funding
Institutional / Administrative Controls	Deed restrictions on property	N/A		Make sure records are being retained	Info regarding requirements of controls	Are the controls working?	Direct program; secure funding
Monitoring and Maintenance	Periodic soil sampling and water sampling downstream to detect possible migration	N/A	N/A		Retain records	Review records; determine need for program adjustments	Direct program; secure funding
Information Management	Historical information about Site and chosen remedy; info on COCs	N/A	N/A	Periodic review of records to determine retention needs, obsolescence of records media.		Periodic review of records	Direct program; secure funding
Periodic Assessment	Determine stability of contamination and possibility of migration; review technology to determine ability for further cleanup	N/A	N/A	N/A	Maintain records of assessments		Direct program; secure funding
Controlling Authority	Direct program; secure funding	N/A	N/A	N/A	Maintain records of activities	Independent external oversight	

4 Stewardship Analysis and Future Cleanup Decisions

As the Stewardship Working Group expands and finalizes the toolbox, it is important to begin examining areas of the Site and regulatory documents where a stewardship analysis may make a difference in the remedy selection or regulatory decision process. The following section identifies key areas of contamination at Rocky Flats where stewardship could influence the remedy analysis and, in turn, cleanup decisions.

4.1 Cleanup Strategies and “Fixed” Versus “Variable” Stewardship Needs

In reviewing the following material, it is important to recognize that for each cleanup action there are essentially four principal remedial strategies for contaminated areas. The agencies may choose to employ two or more of these strategies in combination. Each remedial strategy will drive specific stewardship needs, some of which, as discussed below, are “fixed” and some of which are “variable”. The four cleanup options are as follows:

- No further action (may require additional monitoring or controls);
- Removal and off-site disposal (e.g. excavation of waste or soil and off-site shipment of nuclear or hazardous material);
- Engineered barriers (caps, passive and/or active barriers, sediment ponds, etc.); and
- Stabilization in place.

As noted earlier, it is important to recognize that for each cleanup decision, there will be a set of baseline stewardship needs that will be required no matter which remedy is chosen, short of returning to unrestricted use. The Stewardship Working Group refers to these requirements as “fixed” stewardship needs. Fixed needs for Rocky Flats will likely include, at a minimum:

- information management;
- regulatory reviews and reporting;
- surveillance (security and inspections);
- controlling authority(ies); and
- funding.

Stewardship needs that vary depending on the cleanup decision are referred to as “variable,” and may include:

- the decision of whether to use an engineered barrier and the type of barrier;
- the decision of whether to use physical controls and the type of controls;
- the decision of whether to use institutional controls and the type of controls; and
- the extent and type of monitoring.

Each cleanup action must be analyzed for long-term implications and the eventual risk of failure. The Stewardship Working Group also suggests that, in addition to these requirements, the criteria for evaluating variable long-term stewardship needs should include as a minimum:

- life-cycle costs;
- length of time remedy required/life of the contaminant;
- lifetime of the selected remedy;
- long-term effectiveness of the remedy;
- redundancy (layering of multiple mechanisms);
- contingency plans; and
- acceptance by the community.

Incorporating this type of stewardship analysis into the remedy selection process is consistent with the aforementioned NRC report, which calls for an institutional approach to stewardship that is realistic, systematic, integrative, and comprehensive.

4.2 Rocky Flats OU Sites

Rocky Flats has over 194 Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern (PACs), and Under Building Contamination (UBC) sites, as well as White Space Areas (areas existing outside current IHSS, PAC, and UBC sites) that will require characterization and remediation before the site can be closed. To ensure long-term protection of the community and the environment from residual contamination, the stewardship toolbox described in Section 3 should be utilized to assist in selecting a remedy for each contamination site at Rocky Flats. Following is a description of contaminated areas where the Stewardship Working Group believes stewardship analysis may make a difference in the determination of which cleanup strategy to pursue.

4.2.1 Present Landfill

Location/Background Information:

Located in upper northwest section of the Buffer Zone, the landfill encompasses approximately thirty acres. It contains six IHSS's and PAC's within the boundary. The landfill, which operated from 1968 to 1998, was used for site waste disposal, including sanitary and some industrial wastes. Partial remediation was accomplished in 1992 with the installation of a groundwater barrier surrounding the landfill. Further corrective actions included the installation of a landfill leachate collection and treatment system, which was installed in 1995 and modified in 1998 to meet additional remediation controls. No further action is proposed for this area.

Contaminants of concern:

Metals (lithium), radionuclides, tritium and Volatile Organic Compound's (VOCs).

Potential Remedies:

- 30-acre non-RCRA evapo-transpiration cover with passive air stripping of volatile organic from residual leachate
- RCRA Subtitle C cap
- Combination of Subtitle C and evapo-transpiration caps

Stewardship Implications:

All proposed remedies will require leachate management and/or groundwater treatment. All the remedies will require long-term monitoring and maintenance. Key issues to address are the life expectancy of the caps, maintenance costs, replacement costs, and contingency plans.

4.2.2 Original Landfill

Location/Background Information:

The original landfill encompasses approximately 20 acres in the Buffer Zone, adjacent to the Industrial Area on the hillside north of Woman Creek. The steep hillside served as a ready-made disposal site from 1952 to 1968 for both sanitary and industrial wastes. The steepness of the slope and the process of waste disposal and placement into the landfill have resulted in potential issues associated with the integrity and stability of the hillside.

Contaminants of concern:

Metals, VOCs, and three uranium isotopes, which include depleted uranium. Groundwater below the sites has identified contaminants of barium, manganese and radium.

Potential Remedies:

- 20-acre non-RCRA evapo-transpiration cover with passive air stripping of volatile organic from residual leachate
- RCRA Subtitle C cap
- Combination of Subtitle C and evapo-transpiration caps

Stewardship Implications:

All proposed remedies will require leachate management and/or groundwater treatment. All the remedies will require long-term monitoring and maintenance. Key issues to address are the life expectancy of the caps, maintenance costs, replacement costs, and contingency plans.

4.2.3 Protected Area (PA) – 700 AREA

Location/Background: Location Description:

The greatest source of contamination (~30 acres) at Rocky Flats is from three plutonium-processing buildings, B771/774, B776/777 and B707. These buildings are located in the PA. Extensive under-building contamination exists in the PA where the buildings are located. The area has approximately 31 IHSSs, and it is assumed that complete removal of the contamination will be impractical. These buildings were the sites of fires, spills and inappropriate disposal of contaminated materials. The buildings are connected to a numerous buried utilities and process lines that have leaked sanitary and process waste. Significant subsurface contamination is expected under and near these facilities.

Contaminants of Concern:

Plutonium, americium, VOC's, heavy metals, and other hazardous substances.

Potential Remedies:

- 30 acre, non-RCRA evapo-transpiration cover

- Excavation
- RCRA Subtitle C cap
- Passive barriers to treat groundwater and surface water
- Holding/sediment ponds
- Interceptor trenches or diversion ditches

Three main pieces of data are necessary to help determine the remediation for the entire Industrial Area: actinide migration studies, the water balance study, and the groundwater study.

Stewardship Implications:

Engineered barriers will require long-term monitoring and maintenance. Key issues to address are the life expectancy of the controls, maintenance costs, replacement costs, and contingency plans.

4.2.4 Surface Water Management

Location/Background Information:

RFCA provides that once Rocky Flats is closed, surface water on-site and leaving the site will have to meet 0.15pCi/L (picocuries per liter) for plutonium and americium. Several detention ponds have been constructed on drainage areas to contain flows and allow for contaminants to settle prior to discharge off-site. Water drains from the Industrial Area (IA) into North Walnut Creek (A-series), South Walnut Creek (B-series), and Woman Creek (C-series). There are four A-series ponds, which receive drainage from the IA, including the plutonium processing area. The eastern and southern portion of the IA drains into the five B-series ponds. Two C-series ponds are located on Woman Creek and receive drainage from the south side of the IA and the 903 Pad. It is assumed that future sediment from storm water flows will not exceed the water quality standard identified in RFCA if remediation of source material is removed or contained. Flow volumes and ecological concerns drive remaining water management requirements. All final remedies must be designed to protect surface water for any use.

Contaminants of concern

A-series ponds: radionuclides and PCBs

B-series ponds (2 of them): low levels of radionuclides, semi-volatile organics, and PCBs

C-series ponds: radionuclides

Potential Remedies:

- A combination of erosion and runoff controls and sediment containment to achieve and maintain surface water standards. The results of an erosion modeling study indicate that source removal alone may not guarantee that surface water standards will always be met.
- Some type of detention facilities in both drainages at closure to ensure that radionuclides are afforded settlement time. The ponds have effectively allowed for sediment removal of radionuclides. Options include:
 - wetlands
 - contour the Site to ensure the optimal drainage ensures reduced sediment loading
 - passive barriers
 - SID on the north-side of the IA

- Source removal to a level that would obviate the need for long-term stewardship controls.

Stewardship Implications:

To ensure the water quality standard is met, the Stewardship Working Group assumes engineered controls will have to be used. These controls clearly raise numerous stewardship implications, including: monitoring and maintenance of the engineered barriers and physical controls; maintenance of institutional controls; and records management. Continual maintenance and sampling operations will have to be in place to ensure regulatory compliance for the life of the contaminant. The current holding ponds do not meet requirements for a 100-year storm event, which leaves this option without a viable contingency plan. Groundwater plumes connect with surface water in the Buffer Zone north and east of the IA, so it may be difficult to identify source contamination because of the complexity of the watershed system. Systems will have to be implemented to address this last issue.

4.2.5 Buffer Zone

Location/Background Information: The Buffer Zone surrounds the IA and has the least amount of contamination. Long-term stewardship plans for Rocky Flats must include provisions for ecosystem management, as the area will be retained as open space and likely as a national wildlife refuge. This area requires significant long-term stewardship to protect and sustain the natural resources at the Site. The Site has 1,809 acres of xeric tallgrass prairie, which is a valuable ecological resource for the Denver metropolitan area. The Preble's meadow jumping mouse, a listed species under the federal Endangered Species Act, resides in the Buffer Zone and will have to be protected.

Proposed Remedies:

- Restore habitat

Stewardship Implications:

Long-term stewardship will be required to properly manage the wildlife habitat to promote conservation of Site ecosystems, detection and management of disturbances to Buffer Zone ecology, and protection of natural resources and species of concern.

4.2.6 903 Pad

Location/Background Information:

The 903 Pad closure project includes the 903 Pad Drum Storage Area (IHSS 112), the 903 Lip Area (IHSS 155), and the Americium Zone. Drums that were stored at the 903 Pad between 1958 and 1967 leaked hydraulic fluids and lathe coolant contaminated with radionuclides and VOCs. In 1967, a total of 5,237 drums were at the drum storage site. Approximately 420 drums leaked to some degree and released an estimated 5,000 gallons of contaminated liquid containing approximately 86 grams of plutonium. The Americium Zone, which is east and southeast of the Lip Area, also exhibits levels of elevated plutonium-239/240 and americium-241. The subsurface soils beneath the asphalt pad are contaminated with plutonium and organic contaminants. The radioactive contamination is detected in subsurface soil at a depth of 6"-18".

Contaminated soil volumes based on areas and depths of current Tier I and Tier II RSAL exceedances are: Tier I = 9,536m³ and Tier II = 20,232m³.

Contaminants of Concern:

Plutonium 239/240, Americium 241, Uranium 234, 235, 238, Aroclor-1248, Carbon Tetrachloride, Chloroform, 1,2-Dichloroethene, Methylene Chloride, Tetrachloroethene, and Trichloroethene.

Previous remedy:

From 1968 through 1970, some of the radiologically contaminated material was removed from the 903 Pad and Lip Area. Some of the surrounding Lip Area was regraded and an imported base coarse material covered much of the area. An asphalt cap was placed over the most contaminated area resulting in the 903 Pad. During the clean-up activities, wind and rain (stormwater erosion) spread plutonium-contaminated soils to the east and southeast from the 903 Pad Area resulting in the 902 Lip Area. There have been several limited excavations to remove some of the contaminated soils from the Lip Area, however sampling and analysis results confirm that radiologically contaminated soils remain. Long-term stewardship goals were not part of the methodology in choosing previous remedies at this site.

Potential Remedies:

Soils

- excavation
- thermal desorption (for soils contaminated with VOCs)
- capping

Groundwater

- pump
- pump and treat
- passive barrier
- natural attenuation

Surface Water

- sediment/holding ponds
- utilize current SID and continue with monitoring and maintenance
- water diversion systems
- wetlands

Stewardship Implications:

All engineered barriers will require long-term monitoring and maintenance. Key issues to address are the life expectancy of the controls, maintenance costs, frequency of replacement and costs, redundancy of institutional controls, and contingency plans.

4.3 Observations

Regardless of the chosen remedies there will be important and likely significant "fixed" stewardship needs after the closure of Rocky Flats. These needs will include information

management, regulatory reviews and reporting, surveillance (security and inspections), controlling authority(ies), and long-term funding.

In addition to these “fixed” stewardship needs, there will also be an unknown set of “variable” stewardship needs. It is clear from reviewing both past decisions and areas of the Site where stewardship could make a difference in future remedial decisions that the “variable” stewardship needs are quite broad. While it is understood that there will be some amount of monitoring after closure, the extent and nature is still largely unknown and undecided. For instance, as discussed above, there are various options for protecting water quality, each of which has its own stewardship needs, some of which are exclusive to that particular remedy. Likewise, depending on the chosen remedy, there will likely be a number of engineered barriers that will require varying degrees of performance monitoring and regular maintenance.

The Stewardship Working Group believes the remedy evaluation should include measures that have a high degree of certainty and include laying of multiple mechanisms to ensure the remedy will meet the end-state objectives for the life of the contaminants. The extent to which the Site accepts this suggestion will in turn likely affect the “variable” stewardship needs.

5 Stewardship Conclusions and Recommendations

So where does this all lead us? An examination of past cleanup decisions at Rocky Flats reveals that some long-term stewardship elements were included in the remedy evaluation. However, additional steps are needed to provide for a robust stewardship analysis. The long-term requirements and attributes of the remedy selected must be defined at the planning stage to ensure long-term effectiveness.

In an effort to integrate these long-term considerations into the remedy selection process, the Stewardship Working Group proposes utilizing the stewardship toolbox to analyze the stewardship tools necessary to help protect human health and the environment. Important tools of a stewardship program include physical controls, institutional controls, performance monitoring and maintenance, information management, periodic assessment, and maintaining a responsible controlling authority.

More specifically, given the long-lived nature of various contaminants, mechanisms must be implemented to make certain that the controls utilized are monitored for their effectiveness as long as the contaminants remain. In addition, information about residual contaminants and the associated controls must be maintained. Due to the uncertainty involved in maintaining controls over the life of the contamination, periodic reviews should be utilized to ascertain whether the chosen remedy and related controls remain effective and also whether new technologies exist which would allow for discontinuation of the controls. A permanent authority with responsibility to implement, monitor, and evaluate the remedy and controls over the life of the contamination is also critical. It is this collection of activities that are essential to an effective and enduring long-term stewardship program.

The Stewardship Working Group feels confident that incorporating this type of stewardship analysis into the remedy selection process complements the NRC's call for a stewardship program that is realistic, systematic, integrative, and comprehensive.

5.1 Recommendations

In conclusion, the Rocky Flats Stewardship Working Group offers to both the Rocky Flats Coalition of Local Governments and Rocky Flats Citizens Advisory Board the following recommendations on how stewardship can be improved at Rocky Flats:

1. Stewardship must be a key parameter of the decision making process for selecting remedies. Among the requirements that need to be considered to ensure the long-term protection of human health and the environment are access restriction requirements, duration of the remedy, mechanisms for implementing long-term stewardship obligations and requirements, decision criteria for terminating the remedy, requirements for periodic reviews, and long-term costs. Exactly how much stewardship planning will be required at the remedy selection phase is still an open question that necessitates continued public dialogue.

2. Remedies evaluated should also include measures that have a high degree of certainty and layering of multiple mechanisms to ensure the remedy will meet the end-state objectives for the life of the contaminant.
3. The DOE manager must provide specific guidance for integrating stewardship into the remedy selection process.
4. DOE and Kaiser-Hill should each designate an on-site stewardship program manager to coordinate the stewardship program. Each person should have decision-making authority.
5. DOE and Kaiser-Hill must clarify Kaiser-Hill's responsibilities under the closure contract to incorporate stewardship into cleanup planning.
6. The RFCA principals need to establish a set of guidelines directing how stewardship will be incorporated into remedy selections.